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FEDERAL AVIATION ADMINISTRATION
U.S. DEPARTMENT OF TRANSPORTATION

FAA LOGISTICS CENTER SPECIFICATION

200, 300 and 500 Watt PAR-56 Lamps

This Specification contains 41 pages

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TABLES

FIGURES

DRAWINGS

1.0 SCOPE

1.1 Scope

This specification defines the minimum requirements for PAR-56 lamps used for runway approach lighting systems. Approach lighting systems visually assist the aircraft pilot in finding the runway and aligning the aircraft for landing. These systems must operate at maximum power in the most adverse weather conditions

1.2 Classification

This specification defines the following lamps.

Type I lamp, PAR-64, Mogul End Prong Base:
Ordering Designations: Q6.6/PAR/56/2, Q20A/PAR56/C and Q20A/PAR56/1/C.

Type II Lamp, PAR-56, Screw Terminal Base.
Ordering Designations: Q20A/PAR56/2 and Q20APAR56/3.

2. APPLICABLE DOCUMENTS

2.1 FAA Documents

The following FAA documents form a part of this specification.

2.1.1 FAA Drawings

DE-B-3388	Design Concepts, Polymer Closure of Lamps
DE-C-3390	Lamp Life Definition
DE-C-3394-1A	HI-TEMP. Polymer Filler Washer for PAR-56 Lamps in FAA Holders

2.2 Military Documents

The following military and federal documents form a part of this specification and are applicable to the extent specified herein.

2.2.1 Military Standards and Specifications

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-810F	Test Method Standard for Environmental Engineering Considerations and Laboratory Tests

2.3 Other Standard Documents

The following national standards form a part of this specification and are applicable to the extent specified herein.

ANSI/ASQC Z1.4	Sampling Procedure for Inspection by Attributes
ASTM D 3580	Standard Test Method of Vibration (Vertical Sinusoidal Motion) Test of Products
ASTM D 3951	Standard Practice for Commercial Packaging
ASTM D 4169	Standard Practice for Testing of Shipping Containers and Systems
ASTM D 5112	Standard Test Method for Vibration (Horizontal Linear Sinusoidal Motion) Test of Products

2.4 Document Availability

Copies of this specification, other applicable FAA specifications and FAA drawings may be obtained from the Contracting Officer in the office issuing the Screening Information Request (SIR).

Copies of MIL-STD-129 and MIL-STD-810 can be obtained from:
DODSSP
Customer Service
Standardization Documents Order Desk
700 Robbins Avenue, building 4D
Philadelphia, PA 19111-5094

Copies of ASTM documents can be obtained from:
ASTM
100 Barr Harbor Dr.
West Conshohocken, PA 19428
Telephone (610)-832-9500

2.5 Precedence

In case of conflict between this specification and the specifications and standards referenced in 2.1, 2.2 and 2.3, this specification shall govern. The contractor shall notify the Contracting Officer in writing, of any conflicts discovered and not resolved by this order of precedence.

3. REQUIREMENTS

3.1 General

The lamps of this specification are used for outdoor operation. All lamps shall be sealed in a PAR-56 envelope, consisting of internally coated reflector and a lens or cover glass, as shown in Figures 1 and 2. Lamps with mogul end prongs (Figure 1) shall be for installation in above ground lamp holders, and lamps with screw terminals (Figure 2) shall be for installation below the surface in semi-flush approach lighting fixtures.

Type I lamps, mounted in FAA lamp holders with and without the high temperature polymer washer, are installed in the approach areas to runways extending from the landing threshold outward.

Type II lamps are installed in flush mounted enclosures, located on the extended centerline of the runway, as typically described by Figure 3.

The lamps shall function in their lamp holders in continuous or intermittent outdoor service under the environmental conditions specified herein

Coated lamps, lamps with a film on the lens, are not acceptable unless the following criteria is met: The offerer must submit definitive test results proving the coating will not separate from the lens nor become opaque, i.e. lose more than five percent (5%) transmittance of visible light, after two (2) years of operation with exposure to sunlight as part of the bid or proposal. This actinic immunity shall be proven using Procedure II, Method 505.4 of MIL-STD-810F, and irradiance intensity of 1120 watts per square meter.

All further references to lamps in 3.2 through 6.8 hereafter, refer to both coated lamps and uncoated lamps.

3.2 Requirements for all specified lamps

3.2.1 Fungus Proof Materials

Whenever practicable, materials that are nutrients for fungi shall not be used. When such materials must be used and are not hermetically sealed, they shall be treated with a fungicide agent. The fungicide shall be approved as safe for human contact if applied to the exterior of the lamp.

3.2.2 Metals

Metals shall be inherently corrosion resistant.

3.2.3 Mogul End Prong and Screw Terminals

Mogul end prongs of Type I lamps shall conform to the physical dimensions shown in Figure 1. A nominal 0.430-inch long, flat, prong surface shall be provided for attachment of a lamp connector.

Screw terminal lugs of Type II lamps shall be straight and flat. Threads in the lug and on the mating screw shall be free of deformation and burrs.

3.2.4 Marking

All lamps shall be permanently marked on the back of the reflector body with the ordering designation, rated wattage, rated current, day, month and year of manufacture and the manufacturer's name, logo or trademark or CAGE code.

The marking shall be permanent and remain legible up to the minus three sigma (-3σ) hours of rated life of the specific lamp design submitted for qualification.

The manufacturer's name, logo or trademark molded into the lens or body of the lamp may be substituted for that portion only of the requirements of the preceding paragraph.

3.2.5 Workmanship

All lamps shall be free from blemishes and defects. Marking shall be clear, legible, and durable. Soldering, welding, brazing, cementing, and wiring shall be thorough. Alignment of parts shall be accurate. The mogul end prongs and screw terminal lugs shall be straight, flat, without bends, twists or burrs. The sealed lamp shall be free of loose internal items and debris.

3.2.6 Cleaning

All lamps shall be thoroughly cleaned, and all loose, spattered, or excess solder, metal chips, flux, and other foreign material shall be removed during and after final assembly.

3.2.7 Packing, Packaging and Marking

All lamps shall be packed, packaged and marked for storage and reshipment in accordance with Section 5.

3.3 Reserved - Equipment to be furnished by the Contractor. Not applicable

3.4 Lamp Performance Requirements

3.4.1 Wattage Rating

The wattage ratings shown in Table Table II and I are the maximum wattage ratings for the specific lamp. All references to rated power are referring to the maximum current rating of the specific lamp. The wattage tolerance for all lamps is plus or minus five percent (±5%). Wattage shall be measured over a one minute time period and is the average power measured in this one minute. The measurement shall be taken after the lamp has been conditioned or burned in for a period of time equal to one percent (1%) of the rated life of the submitted lamp design. No individual lamp shall have less than ninety five percent (95%) or exceed one hundred five percent (105%) of the average measured wattage rating of the design qualification sample.

The following formula will be used to adjust the offered price for all qualified lamp designs: Wattage, average value for the offered design sample as established by the qualification testing, times the hours of operation yielding the least cost of ownership by the FAA for the design, times $0.048 per kilowatt hour.

Table I and Table II specified values for wattage are the maximum acceptable wattage ratings for each ordering designation lamp. More energy efficient designs will have their offered price adjusted downward. Refer to section 3.4.5, Life.

3.4.2 Candela

The minimum acceptable candela values and the distribution of candela in the beam of each specific ordering designation lamp are specified in Table I and Table II. All luminous quantities specified or required by this specification are the sum of the visible radiant energy from a wavelength of three hundred-eighty nanometers (380nm) to seven hundred-seventy nanometers (770nm) inclusive.

All twenty (20) ampere rated lamps shall deliver illuminants at 3000°Kelvin (K) to 3200°K color temperature at rated power reducing to a minimum 2100°K color temperature at the minimum power level of eight (8) amperes.

All six point six (6.6) ampere rated lamps shall deliver illuminants at 3000°K to 3200°K color temperature at rated power reducing to a minimum of 2800°K color temperature at 4.0 amperes.

All offers shall include as part of the offer the beam and field candela distributions in isocandela diagram format, and the total lumen output of the offered lamp design.

3.4.3 Short Term Overload

Lamps shall be capable of operating at one hundred ten percent (110%) of full rated power for a period of two (2) minutes, once per hour (two (2) of every sixty (60) minutes with no failure

3.4.4 Operating Power Range

All lamps specified by this specification are operated over a wide range of alternating current (AC) input to adjust their intensity to atmospheric conditions at the time. All references to current rating or input in this document are to root mean square (rms) AC current. All lamps specified herein shall operate as a halogen cycle lamp over the entire range of input power specified.

Twenty (20) ampere lamps shall operate at any input current from a minimum of eight (8) amperes to the rated power of twenty (20) amperes.

Six point six (6.6) ampere lamps shall operate at any input current from a minimum of four (4) amperes to the rated power of six point six (6.6) amperes.

3.4.4.1 Candela Output over Operating Power Range

The candela output of all lamps shall be within three percent (±3%) of the lumen output predicted by the following equation over the entire input power range specified.
The beam candela of the lamp shall be used to determine compliance.

$$\frac{\text{candela}}{\textbf{CANDELA}} = \left\lceil \frac{\text{amperes}}{\textbf{AMPERES}} \right\rceil^{5.56\ \text{(exponent)}}$$

lower case are less than rated values
Bold CAPITALS are RATED VALUES

3.4.4.2 Operating Power Characteristics

The FAA systems, in which all lamps defined by this specification are operated, power each lamp with an alternating current (AC) waveform of voltage that contains a high number and significant amount of harmonics of the nominal sixty hertz (60Hz) input frequency. The exact harmonic content varies by system. All systems produce a distribution of harmonics described by the Fourier equations. The dominant harmonics are the odd, i.e. 3rd, 5th, and 7th, up to the 31st. Selected systems contain even number harmonics when operated at lower power steps.

Lamps defined by this specification shall meet all other specified requirements when operated continuously at maximum current rating with an imposed peak voltage of one hundred twenty five percent (125%) of the peak voltage that would be imposed by an undistorted sixty hertz (60Hz) voltage waveform.

An example*: A nominal three hundred (300) watt, twenty (20) ampere lamp would have a nominal steady state impedance of three quarters (0.75) ohm at nominal full power.*

The root mean square (rms) voltage imposed on the lamp filament would be fifteen (15) volts. The peak voltage imposed on the lamp filament by an undistorted fifteen (15) volt rms voltage waveform would be twenty one point two (21.2) volts.

The distorted voltage waveform supplied by FAA systems can have a peak voltage of twenty-six point five (26.5) peak volts with an rms voltage of 15 volts.

Information: All FAA systems produce waveforms of higher harmonic content at less than full power. All known national and international test protocols require voltage waveforms with approximately one half the distortion produced by the known least distorted FAA system at full power.

3.4.5 Life

The life of current regulated lamps to be provided in accordance with this specification is defined by FAA drawing DE-B-3390A.

The terms; rated life, average life, rated average life, and average rated life, shall all be considered as defining the same period of time. Twenty (20) ampere rated Lamps defined by this specification shall have a rated life one thousand (1,000) hours. Six point six (6.6) ampere rated lamps shall have a rated life of two thousand (2,000) hours. Offers with greater, or lesser, rated life will be considered.

All lamp designs shall include the standard deviation (sigma)(σ) of lamp life hours and rated life hours for the specific lamp design offered.

In addition to all other specified requirements for lamp life: The rated life of all lamps is defined as ended when the lamp wattage at rated power exceeds the initial wattage value established for the specific lamp by the qualification wattage test (4.5.2.1) by fifteen percent (>115%).

The basic equation for the cost of ownership of lamps is:
$ = N(.xxx)($L)(SL$) + N($L)(GL$). N equals the number of lamps in the specific system. (.xxx) equals the decimal equivalent of sigma, or the decimal of the percentage of lamps expected to fail at the point in time. $L equals the cost of the lamp. SL$ equals the cost of spot replacement for a single lamp. GL$ equals the cost per lamp for group relamping the entire system.

The cost of ownership of each offered design will be calculated at the minus three, minus two and minus one sigma (-3σ, -2σ,and -1σ) values for the specific design using the

offered lamp price, and lamp numbers and relamping costs appropriate to the system(s) that use the ordering designation(s) identified in the Screening Information Request (SIR).

3.4.6 Candela Maintenance

The lamp beam candela output after the hours of full power operation required to attain the minus three sigma (-3σ) life of the submitted lamp design shall be no less than ninety five percent (95%) of the initial beam candela output.

3.4.7 Lamp Dimensions

The PAR-56 lamp shall meet the dimensions and tolerances specified in Figure 1 or Figure 2 as applicable to the lamp type. Note the outside lamp diameter tolerance defined by Figure 1. The tolerance range is identical to the lens ledge diameter tolerance of the last forty-five (45) years.

3.4.8 Environmental Requirements.

3.4.8.1 General

Lamps shall operate as a halogen cycle lamp, in their appropriate FAA holder, in the range of environmental conditions specified.

3.4.8.2 Temperature

Type I lamps, any ambient air temperature between -60°F (-51°C) and +120°F (+49°C).

Type II lamps, any ambient air temperature between -40°F (-40°C) and +300F (+149°C).

3.4.8.3 Altitude

Type I and Type II lamps, any altitude from sea level to 10,000 feet (3,048 meters) above sea level

3.4.8.4 Humidity

Type I and Type II lamps, any relative humidity between zero and one hundred percent (0% to 100%) over the ambient air temperature range specified.

3.4.8.5 Salt Fog

Type I and Type II lamps, exposure to salt laden atmosphere.

3.4.8.6 Cold Rain

Type I lamps, exposure to wind-blown cold rain.

3.4.8.7 Sand and Dust

Type I lamps, exposure to wind blown sand and dust.

3.4.8.8 Vibration

All lamp designs shall be for rough service. The diversity of support structures for FAA holders is such that specific frequencies and amplitudes cannot be defined. Structures usually resonate at relatively low frequencies.

Each and every specific lamp design shall include those specific frequencies that will result in the lamp filament and/or filament capsule in harmonic resonance. The range of frequency data required is from one (1) to two hundred (200) Hertz. No harmonic resonance in the frequency range of one (1) to one hundred (100) Hertz is required with the lamp both un-powered, and operating at rated power.

Harmonic resonance, as used herein, means these parts exhibit an increase in physical movement at a specific frequency, analogous to a vehicle (filament) vibrating from an out of balance tire (propeller harmonic).

MIL-STD-810F Method 514.5, VIBRATION, Procedure I and Method 516.5, SHOCK, Procedure I, provide rationale and guidance for the necessary three (3) axis testing. Additional guidance may be found in ASTM D 3580 and ASTM D 5112.

3.5 Reserved

3.6 Optional Designs

Design details not specified are optional. The physical appearance of the lamp shown in Figures 1 and 2 is preferred. Minor variations will be permitted, provided performance requirements are met, the lamp is physically interchangeable with those depicted in Figures 1 and 2, and the procuring authority approves the design.

The specified performance, severe environmental requirements included, and physical and electrical compatibility with existing equipment are necessary.
The basic criteria for optional designs are: Function, power input and light output, is identical to the specified lamp; Fit, design fits in the same holders; Form, resembles or is recognizable as a light source.

Optional designs will be considered and may be approved by the procuring authority.

3.6.1 Environmental Considerations

It is understood that the environmental requirements of this specification require lamps to endure a simultaneously large, severe, and rapid change in temperature. The Glass Engineering Handbook, 3rd edition, authors McLellan and Shand, explains the parameters and requirements for enduring thermal shock quite well in chapters 2, 4 and 5.

3.6.2 Thermal Effects

The FAA has performed limited basic research to define the temperature profiles of lamps mounted in standard FAA specified lamp holders. Holders were set at a lamp twenty degrees (20°) base down angle to the horizontal for all tests whose results are mentioned in this specification section.

The research was conducted to investigate the actual temperatures of nominal 300 watt lamps operating at rated power and to validate the design concepts shared herein, are viable.

The center portion of all lamp lens or cover and the top, as mounted in a holder are consistently the zones of highest temperature. The sides of the lens or cover were consistently the cooler zones. Surface temperature differences as high as 185 degrees Fahrenheit (185°F) (85°C) were found between the geometric center of the lens or cover and within one half inch (1/2”) of the edge of the lens.

The temperature gradients measured were consistent with three different lamp designs, each tested in six different mounting conditions. It was also noted that measured temperature would vary considerably if taken at very small differences in position from the theoretical specified point.

The dramatic measured differences in lens/cover temperatures with small changes in measurement location also point to the need to include thermal
conductivity of the lens material in the design criteria. The optimum design would have very small and uniform temperature gradients within the lens.

The high temperature of the center and top portions is understandable when the energy intensity, specified by another acquisition specification, to be radiated as visible light is added to by the unseen radiated heat energy.

The cooler sides of the lens are understandable as they correspond to the ends of the linear filaments of the lamp. Very little visible light or invisible heat is radiated directly at these points by the ends of these straight filaments or their lead wires.

A conclusion that can be made from the combination of these two common effects is that perhaps a curved filament design would improve the uniformity of radiated heat and light directed to the lamp lens. Reflector and filament geometry optimization might be eased by use of a coating on the lamp capsule such as is commonly used on automotive duty headlamp capsules.

The candela distribution specified as the minimum requirement in this specification is one of historic use. Previous acquisition specifications have allowed concentrations of energy that accentuate the environmental stress problems.

3.6.3 Method to Minimize Thermal Stress Effects

The design concepts illustrated on FAA drawing DE-B-3388, titled Design Concepts, Polymer Closure of Lamps offer a potential economical solution for the problem of designing and manufacturing lamps which must be subjected to severe environmental stress. The Glass Engineering Handbook validates freedom from mechanical restraint and compatible and coordinated coefficients of thermal expansion for joined parts, lamp lens to body, are needed.

The customary tongue and groove used to position the lens on the body of lamps is one that concentrates stress by design. Manufacturers of adhesives used for assembly of products with inherent high operating to idle temperature changes advise junctions which do not concentrate stress when differential expansion is known to exist. The customary design helps the adhesive performance but increases the potential for thermal stress of the glass parts.

Examination of glass manufacturers catalog literature reveals wide ranges of thermal expansion coefficient glasses are available as standard items. The handbook states that the lower the coefficient of thermal expansion, the higher the resistance to failure due to thermal stress. The coefficients of epoxy products used to bond lamp parts together should match the part coefficients, if a design is to be more immune to thermal shock.

The design concepts presented in this specification illustrate several means of isolating or minimizing the interaction of lens or cover and lamp body as thermal expansion and contraction occur. The exact details and geometry of the interposing junction require a structured development program. The exact material used to mechanically isolate or dampen or minimize the transfer of stress between lamp parts will affect the mechanical details of the junction.

The application of these design concepts extends to any lamp that has a light source within a larger envelope or enclosure.

The use of a polymer for closure and sealing may require a bonding agent between the polymer and the lamp parts. Design concept drawing DE-B-3388 does not illustrate or mention bonding agents.

Polymers, which can endure the temperature ranges, environmental contaminants and direct sun light, have existed for years. They can be formulated to have a wide range of physical properties such as; porosity, flexibility, tensile and compressive strength, hardness and adherence to other materials.

An excellent academic source of polymer engineering is:

The University of Akron, College of Polymer Science and Polymer Engineering, Akron Ohio. The College telephone is 330-972-6865. Mailing address: University of Akron, Department of Polymer Science, 260 S. Forge, Akron OH 44325-0301.
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4. QUALITY ASSURANCE PROVISIONS.

4.1 Quality Control by Contractor

As a minimum, the manufacturer of lamps furnished in accordance with this specification shall have and maintain a quality control program in accordance with ISO 10005, Quality management - Guidelines for quality plans.

ISO 9001 or ISO 9002 registration of the lamp manufacturer will be accepted as verification of the required quality control program. The FAA may audit the manufacturers quality control program at its sole discretion. All contractors shall provide either proof of the manufacturer's ISO registration or a copy of the manufacturer's quality control plan.

4.2 Government Inspection

The term "government inspection" used in this specification includes, but is not limited to: Inspection for the government by a qualified laboratory, FAA witnessing contractor's testing, FAA testing, and FAA inspection, as deemed
necessary to verify compliance with the requirements of this specification and all requirements of the contract.

The words "defect" and "nonconformance" shall be used interchangeably, as are "rejected" and "nonconforming". Critical items are those that are cause for rejection.

Major items are those which may be corrected by the contractor and, in general; do not usually affect the life or performance of the lamp.

4.2.1 Critical Defects or Nonconformances

Any cracking, separation, or fracture of the lens, cover, body or assembly of the lamp. Failure to operate as a lamp. Failure to deliver and maintain the minimum specified light output and distribution of light output. Failure to meet the rated life of the specific lamp design. Any failure to meet specified performances of the qualification tests for the lamp type. Lamp size or shape not as specified.

4.2.2 Major Defects or Nonconformances

Packaging, packing, dirty lamp interior, markings not permanent, terminals bent, curved or corroded.

4.3 Qualification Testing

Qualification testing is the process of verifying offered lamp designs can meet the requirements of this specification. The requirements of this specification are the minimum requirements for qualification of each specific lamp design. Offered lamp designs which pass qualification testing will be designated a qualified product.

The critical and major defects listed in 4.2.1 and 4.2.2 apply to all qualification tests in addition to the specific requirements of the test(s). Sequential numbers shall individually identify all lamps in each submitted qualification sample. These lamp numbers shall be referenced for the duration of testing.

The hours of full power operation of each lamp shall be recorded for each specific test requiring full power operation. These recorded hours shall be included in the total hours of full power operation for the Life and Candela Maintenance Test, reference 4.2.5.7.

A qualified independent testing laboratory employed by the FAA will perform qualification testing. The contractor shall submit thirty (30) samples of each offered Type I lamp design, or twenty two (22) samples of each offered Type II lamp design for qualification tests.

The qualification samples will be returned to the offering contractor at the completion of testing with a copy of the test results for the contractor’s qualification sample.

4.3.1 Qualification Testing of Type I Lamps

Twenty seven (27) of the thirty (30) submitted qualification sample lamps will be tested for Life and Candela Maintenance, Wattage and Photometrics. All shall pass for qualification.

Twenty (20) of the thirty (30) submitted qualification sample lamps will be randomly selected for specific tests required by Table III. All twenty (20) lamps shall pass these three (3) tests to become a qualified product.

Seven (7) of the remaining ten (10) submitted qualification sample lamps will be randomly selected for the specific tests required by Table III. All seven (7) lamps must pass these four (4) tests to become a qualified product. Four (4) of these seven (7) lamps will be tested in FAA holders equipped with the high temperature polymer washer. The remaining three (3) of these seven (7) will be tested in FAA holders without the high temperature polymer washer.

Twenty (20) lamps will be tested for thermal shock, reference 4.5.2.5. Ten (10) of the twenty (20) will be tested with the high temperature polymer washer. The remaining ten (10) will be tested without the high temperature polymer washer.

The remaining three (3) submitted sample lamps will be used as replacements for any lamps accidentally damaged or destroyed during testing. If the testing laboratory damages or destroys more than three (3) submitted sample lamps from any lot of thirty (30) the contracting officer may allow the submitting contractor to furnish replacements.

4.3.2 Qualification Testing of Type II Lamps

Type II lamps are not exposed to all the severe environmental stresses of Type I lamps. Type II lamps are used in flush mounted enclosures that are set in concrete and earth. Water exposure is limited to humidity in the enclosure, and the operating ambient air temperature of the enclosure can exceed three hundred degrees Fahrenheit (+300°F)(149°C) at full power.

Twenty (20) of the twenty two (22) submitted qualification sample lamps will be randomly selected for testing as required by Table III. The remaining two (2) lamps will be used as replacements for any lamps accidentally damaged or destroyed during testing. If the testing laboratory damages or destroys more than two (2) submitted sample lamps from any lot of twenty two (22) the contracting officer may allow the submitting contractor to furnish replacements.

All twenty (20) lamps shall pass these eight (8) tests to become a qualified product.

4.3.3 Qualified Lamps

Qualified lamp designs shall remain qualified unless disqualified as a result of Acceptance Testing (4.4) or the defining FAA specification is changed. The FAA may elect to re-qualify all lamps of any or all ordering designations in the future.

4.4 Acceptance Testing

Acceptance testing is the process of verifying qualified lamps supplied the FAA are being manufactured to meet the lamp design performance capability verified by qualification testing. Acceptance of all lamps is at destination. The FAA, or agents of the FAA, shall at the sole discretion of the FAA, test and inspect all lamps received on a lot basis. Acceptance inspection will be done at the sole discretion of the FAA.

A lot is hereby defined as all lamps of one qualified design and source received at the same time and day and listed on one (1) transportation document by the carrier. These lots will be tested on a sampling basis in accordance with ANSI/ASQCZ1.4-1993. The Acceptable Quality Level, AQL, is 1.0 for all lamps defined by this specification.

The Inspection Level will begin with Level I. The inspection level will be adjusted according to the switching rules for the ANSI Z1.4 system defined by Figure 1 of Z1.4. Reduced inspection shall be Level S-4 and tightened inspection shall be Level II.

4.4.1 Waiver of Acceptance Testing

Inspection of finished products is an added cost. Contractors whose manufacturing process contains a documented and auditable multiple year record of manufacturing and delivering like products with an equal or lower rate of non-conformance (AQL $\leq$ 1.0) may request a waiver in their proposal.

The FAA will audit the contractor's records. The audit may include witnessing the manufacturing process. When the FAA grants a waiver of acceptance testing, the contractor shall supply Certificates of Conformance. Each and every lot shipped to the FAA will include the Certificate for that lot. A duplicate Certificate will be mailed or electronically transmitted to the Quality and Reliability Officer (QRO) assigned to monitor the acquisition. The Contracting Officer issuing the formal documents for the acquisition will identify the QRO in the formal documents.

A responsible employee of the contractor shall sign all Certificates of Conformance. The contractor shall furnish a current list of authorized individuals to the FAA Contracting Officer. The certificates of conformance shall identify the number of lamps, identified by their date of manufacture and ordering designation, in each lot shipment.

4.4.2 Acceptance Tests

All lots will be visually inspected for transit damage. Inspection of the samples selected for acceptance testing will include; marking, packaging, concealed damage, physical dimensions and specified cleanliness of the lamp.
Acceptance testing will normally consist of: Photometric Tests, Wattage/Rating Test, Short Term Overload Test and Cold Rain Test. The FAA shall at its sole discretion, expand acceptance testing to include any other, or all, qualification tests.

4.4.3 Acceptance Inspection/Testing and Disqualification

The FAA will begin acceptance inspection at inspection Level I sampling rates and anticipates reducing the level of inspection to Level S-4. The Switching Rules for ANSI Z1.4, Figure 1, are modified as follows: If the Inspection Level is increased from Level I to Level II, the non-acceptance of 3 consecutive lots constitutes disqualification of the lamp. All expenses for re-qualification of the lamp shall be borne by the contractor. An independent testing laboratory accepted by the cognizant FAA contracting officer shall re-qualify the lamp design.

4.4.4 Nonconforming or Rejected Lots

All lots found nonconforming by acceptance inspection and/or testing are the sole responsibility of the contractor, at the place of inspection or testing, when found nonconforming. The FAA, at its sole discretion, may elect to accept portions of nonconforming lots.

4.5 Test Methods.

4.5.1 General

Testing of all lamps shall be as defined in this specification. Unless specified differently in a specific test, the following General Laboratory Test Method Guidelines, of section 5, of MIL-STD-810F, shall be followed:

5.1 Standard Ambient Test Conditions.,
5.2 Tolerances for Test Conditions.,
5.3.1 Suitability for environment.,
5.3.2 Calibration.,
5.4 Stabilizing Test Temperature,
5.4.1 Test item operating.,
5.4.2 Test item non-operating.,
5.8.1 Installing the test item in test facility.,
5.8.2 Test item operation.,
5.10 Information during Test.,

All of 5.11 Interrupted Tests including 5.11.1, 5.11.2, 5.11.3., 5.16 Water Purity., and 5.18.1 Monitoring test chamber parameters. All other requirements of aforementioned section 5 are specifically excluded.

The tests required by this specification are those that represent the operating environment for the specific lamp. Historically there has been an overemphasis of higher temperature operation. The inherent characteristics of incandescent-halogen lamps require elevated internal temperatures to achieve the halogen cycle. High environmental temperatures are of concern for Type I lamps that are vulnerable to structural failure when subjected to cold precipitation.

The successful use of both Types I and II lamps in the colder geographic areas of FAA operation have historically created a standing order to maintain the lamps energized at their lowest input power level. The low temperature and icing tests include photometric tests to define the response of each offered design and validate the order to maintain continuous lamp power in cold conditions.

4.5.1.1 Physical Mounting

Severe environmental testing of Type I lamps shall be performed with the lamp mounted in a FAA holder equipped with and without the high temperature polymer washer. The holder(s) shall be mounted on top of two foot (2') length of two-inch (2") schedule 80 PVC pipe using the slip fitting normally used to mount the holder. The bottom of the 2" pipe may be supported by any method that provides a mechanically stable configuration.

The majority of the lamp heat energy that is not radiated from the lamp lens or cover is dissipated by conduction to the holder and supporting structure. This mounting configuration will approximate the actual conditions that exist in selected locations and provide a uniform test.

Laboratory High Temperature and Humidity testing of Type II lamps shall be performed with the lamp mounted base down in the FAA supplied test enclosure.

All other testing of both Types I and II lamps shall be done in fixtures, jigs or holders appropriate to the specific test or sequence of tests. This apparatus shall be capable of mechanically aligning and holding the lamp in a consistent and repetitive position. The ranges of tolerances of lamp dimensions shall not affect the repetitive accuracy of mounting.

4.5.1.2 Test Voltage and Current.

Lamps furnished to conform to the requirements of this specification shall be tested for qualification and acceptance with sixty Hertz (60Hz) alternating current power containing

three percent (3%)total harmonic distortion, or less, of the fundamental (60Hz) frequency (≤ 3%THDF).

Copper wire, minimum American Wire Gauge (AWG) according to the following table shall be used from the terminals of the power supply to the connector to the lamp mogul prongs or screw terminal lugs.

Maximum Distance by wire length:	20 feet	30 feet	50 feet
Minimum Wire AWG:	#10 AWG	#8 AWG	#6 AWG

Application of full rated power for all twenty (20) ampere rated lamps, for all tests shall be done as follows. Power shall be applied at a voltage that produces a lamp current of eight (8) amperes. After three seconds of eight (8) ampere operation, voltage shall be ramp increased to full rated (20 amperes lamp current) within three (3) seconds.

Application of full rated power for all six point six (6.6) ampere rated lamps shall apply power at four (4) amperes lamp current. After three (3) seconds the current shall be ramp increased to full rated within three (3) seconds.

4.5.1.3 Initial Conditioning (Burn-in)

.

All lamps will be conditioned prior to testing. Conditioning will consist of full power operation for one percent (1%) of the rated life of the lamp design, i.e. a 1,000-hour rated life lamp would be operated at full power for ten (10) hours. The lamp shall be operated with sixty-hertz (60Hz) alternating current and the current shall be controlled within a range of plus zero percent (+0%), minus one percent (-1%) of rated current.

Lamps may be conditioned in a series circuit group. If conditioning is done in series, shorting devices shall be used to allow individual lamps to be removed for wattage testing. Series loop current shall be reduced prior to the removal of any lamp to avoid over-current of the remaining energized lamps.

4.5.2 Specific Tests.

4.5.2.1 Wattage Rating Test

The lamp shall be operated at full rated power for thirty (30) minutes prior to wattage measurement. All lamps shall be consistently and uniformly shielded from air movement other than the convection movement created by the lamp itself during this test.

Power supply voltage shall be set to produce rated lamp current after these thirty (30) minutes and not changed during the lamp wattage measurement. The power supply voltage shall be regulated within one-tenth percent (1/10%) of setting.

Lamp actual wattage is defined as the average watts measured over a one (1) minute interval. Maximum and minimum watts shall also be recorded during this one-minute interval.

The average of all actual lamp wattages measured in each submitted sample shall establish the wattage rating for the submitted design.

Instrument accuracy shall be a plus or minus one-tenth of one percent (±0.1%) of reading, or better. The measured current and voltage values shall be continuously recorded or logged during the one (1) minute measurement interval.

Voltage shall be measured directly at the lamp mogul prongs or screw terminal, not at any type connector used to connect the power leads to the lamp.

4.5.2.2 Photometric Tests

Photometric tests shall be conducted at rated power to validate compliance with the intensity and beam dimension requirements of Table I or Table II. Each lamp shall be energized, set at full rated power, and operated at full power until it is as stable as demonstrated during the wattage-rating test. The photometric measurements shall not begin until this stability is demonstrated.

After the beam dimension and intensity measurements at rated power, without removing or disturbing the lamp, compliance with the requirements for Candela Output over Operating Power Range shall be verified.

The input current to 20 ampere rated lamps shall be reduced in sequence from 20 amperes to 16, 12, 10, and 8 amperes and the beam pattern and intensity of each lamp shall be measured at each input current value.

The input current for 6.6 ampere rated lamps shall be reduced to 5 and 4 amperes respectively and the beam pattern and intensity measured at each input current value. The lamp shall remain in the test fixture for the overload and photometric test.

4.5.2.3 Overload and Photometric Test

The test chamber ambient air temperature shall remain as specified by the Photometrics Test. The lamp shall be operated for one hundred twenty (120) seconds (2 minutes) at 110% rated power immediately following the completion of the Photometrics Test.

The lamp input power shall then be reduced to rated and operated for thirty (30) minutes. A Wattage Rating measurement (one minute) shall be repeated immediately following

this 30 minute equalizing period. Photometric measurements shall be made to define the results of the overload test.

Failure is defined as any one or more of the following:

A. Destruction of the filament.
B. Distortions of the filament resulting in a one degree (1°), or greater, change in the center axis of the beam in either the vertical or horizontal position.
C. Change in beam size and/or intensity greater than two percent (2%).
D. Wattage rating measurement differing more than one percent (1%) from previous measurement.

4.5.2.4 Low Pressure Test

The low-pressure test shall be conducted in accordance with MIL-STD-810F, Method 500.4, Procedure II. The lamp shall be tested at atmospheric pressures corresponding to 10,000 feet (3,048 meters) altitude. Type I lamps shall be tested at -60°F (-51°C). Type II lamps shall be tested at -40°F/-40°C.

Lamps shall be mounted in an FAA holder as specified by section 4.5.1.1 for this test.

Lamps shall be tested for a total of six cycles of rated power operation with a power off interval with the test chamber pressure and temperature maintained constant. A cycle is defined as operation for one (1) hour at rated power, followed by one-half (1/2) hour off.

Photometrics measurements shall be made to define any change in lamp output. The A, B, C and D requirements of the Overload Test also apply to the Low Pressure Test.

4.5.2.5 Cold Rain Test

This test shall be conducted in accordance with MIL-STD-810F, Method 506.4, Procedure I. Rainfall rate shall be four (4) inches per hour driven at a velocity of forty miles per hour (40mph)(18 m/s). The rain shall be directed to strike the lamp face parallel with the mechanical axis of the lamp, perpendicular to the lens surface plane in other words.

The lamp shall be mounted in any standard FAA PAR-56 lamp holder with and without a high temperature washer, with its longitudinal mechanical axis tilted 25° upward (lamp 25° base down). The lamp shall be operated with rated current in a one hundred degree Fahrenheit plus or minus two (2) degrees Fahrenheit (+100°F ±2°F)(+38°C ±1°C) ambient air temperature environment.

The lamp shall then be sprayed four (4) times with water having a temperature of +32°F to +34°F (0 to +1°C) for fifteen (15) seconds at four intervals. The first spray shall be

done fifteen (15) minutes after the lamp is energized, the second spray after thirty (30) minutes, the third after forty five (45) minutes, and the fourth at one (1) hour of full power operation. This is a thermal shock resistance test.

In addition, when there is a coating on the lens or cover, the adhesion test defined in Severe Environmental Tests (4.5.2.6) shall be performed when the lamp has cooled to laboratory ambient temperature.

4.5.2.6 Severe Environmental Tests

Tests shall be conducted on the lamp as defined in the subparagraphs below. At the completion of each test, the lamp shall be thoroughly examined for defects.

The Icing Test, High Temperature & Humidity Test, Low Temperature Test, Sand and Dust, and Salt Fog Test shall all include the following coating adhesion test that shall be performed on any coated lens or coated cover lamp.

Cut a one-inch (1") square into the surface coating. Adhesive tape, commercial item A-A-883 (NSN 7510-01-031-3129) shall be placed centered over the square cut into the surface and removed after five minutes. The adhesive tape shall be of sufficient length to allow removal with the removing force applied at right angles to the surface. Any peeling of the lens protective coating, from the area under the tape, or visible anywhere on the lens surface, constitutes failure of the test.

4.5.2.6.1 High Temperature and Humidity Test

This test shall be performed with the Type II lamp mounted in the FAA test enclosure with the enclosure in a ambient air temperature of one hundred degrees Fahrenheit plus or minus five degrees (100°±5°F)(38°±3°C) for the duration of the test.

The FAA test enclosure shall be filled with water to a depth of six inches (6"). The ambient air temperature of the FAA test enclosure shall be continuously monitored and recorded for the complete test duration.

Water depth in the test enclosure shall be checked and filled as required during the last hour of each six-hour lamp de-energized (off) period so that each lamp energized cycle begins with six inches of water in the enclosure.

The enclosure shall be closed and the lamp energized at rated power for twelve (12) continuous hours. The lamp shall then be de-energized and allowed to cool in the test enclosure for six (6) continuous hours. These twelve hours on-six hours off, operating cycles shall be repeated a total of six (6) complete cycles.

At the conclusion of this test the FAA test enclosure and lamp shall be cooled in standard laboratory ambient conditions. The enclosure shall be opened, the lamp removed, and the lamp examined for defects.

The lamp envelope shall be intact with no cracking or separation of joined parts. There shall be no water inside the body of the lamp. The lamp shall still operate as a lamp for the life and lumen maintenance test.

The coating adhesion test shall be performed when applicable.

4.5.2.6.2 Sand and Dust Test

The sand and dust test shall be performed in accordance with Method 510.4 of MIL-STD-810F. Blown dust concentration as specified by 2.3.2.6.a. Blowing sand as specified by 2.3.2.6.b(2). Test Durations as specified by 2.3.2.8. Lamp energized at full rated power. Lamp shall not lose more than 5% beam candela intensity. Beam pattern size shall not change more than 5% in size in either height or width.

4.5.2.6.3 Salt Fog Test

The salt fog test shall be performed in accordance with Method 509.4, of MIL-STD-810F. The lamp shall be exposed for a total of eighty-six (86) hours. Four consecutive periods of twelve (12) hours wet, twelve (12) hours dry.

The lamp shall be energized at rated power for the duration of the test. Lamp shall not lose more than 5% beam candela intensity. Beam pattern size shall not change more than 5% from initial value. The coating adhesion test shall be performed when applicable.

4.5.2.6.4 Icing Test

The icing test shall be conducted in accordance with Procedure I of Method 521.2 of MIL-STD-810F. Type I lamps shall be mounted as specified in section 4.5.1.1 for this test, lamp twenty five degrees (25°) base down.

The lamp and FAA holder shall be placed in an thirty degree Fahrenheit environment (+30°F ± 2°F) (-1°C ± 1°C) until cooled to this temperature. Water shall then be introduced by suitable means to cause a layer of glaze ice to form on the lamp covering the lens or cover to a thickness of at least one half inch (1/2”)(1.27cm).

After the required thickness of glaze ice has formed, the ice coated lamp temperature shall be reduced to minus thirty two degrees Fahrenheit (-32°F±2°F)(-35.5°C±1°C). The lamp shall be energized with rated current and allowed to operate until the ice melts off.

The lamp shall then be de-energized, removed from the holder, and examined for defects.

A center of beam intensity measurement shall be made. This intensity shall equal the previously measured intensity for the specific lamp in the submitted lot at the conclusion of the Salt Fog Test. The coating adhesion test shall be performed when applicable.

4.5.2.6.5 Low Temperature Test

Type I lamps shall be mounted in any standard FAA holder angled twenty five degrees (25°) up (lamp 25° base down) for this test as specified by section 4.5.1.1.

The low temperature test shall be conducted in accordance with Procedure II, Method 502.4 of MIL-STD-810F. The temperature shall be constant. Type I lamps shall be tested at minus sixty degrees plus or minus two (2) degrees Fahrenheit (-60°F±2°F) (-51°C±1°C). Type II lamps shall be tested mounted in the FAA test enclosure at minus forty degrees plus or minus two degrees Fahrenheit (-40°F±2°F) (-40°C±1°C).

Test chamber test temperature shall be maintained for a period of six (6) hours prior to energizing the lamp. Temperature sensors shall be installed around the lamp in the test chamber.

The lamp shall be energized at rated power, refer to section 4.5.1.2, Test Voltage and Current. The test chamber temperature shall be maintained at minus sixty (-60°F).

A single point, center of beam, measurement of candela shall be made continuously from the time the lamp is energized until the candela has reached the value previously established for the individual lamp by the Icing Test. The time to reach this beam candela value shall be recorded.

If a specific lamp does not reach the specified candela value the test shall be ended when there is no longer an increase in candela of the specific lamp. In addition to the major and minor defects, failure of this test includes the lamp not functioning as a halogen cycle lamp at this low temperature.

It is understood the achievement of internal lamp capsule temperature necessary to initiate and maintain the halogen cycle is dependent on the retention of lamp heat. This test does not include any effects of wind or mounting which adversely affect lamp heat retention.

The coating adhesion test shall be performed when applicable.

4.5.2.7 Life and Candela Maintenance Test

The hours of full power operation of each lamp during previous testing shall be included in the total operating hours of each lamp for this test. Reference section 4.3, Qualification Testing.

Ambient air temperature for Type I lamps shall be fifty four degrees Fahrenheit plus or minus five degrees Fahrenheit (54°F±5°F) (10°C±2.8°C).

Ambient air temperature for Type II lamps shall be one hundred degrees Fahrenheit plus or minus five degrees Fahrenheit (100°F±5°F) (37.7°C±2.8°C).

Ambient air temperature of the test chamber shall be maintained as specified for the duration of all life tests.

The life test shall be done with cycled or interrupted power to the lamp. Refer to section 4.5.1.2, Test Voltage and Current. The lamp shall be operated for twelve (12) continuous hours at full rated power. Power shall then be turned off for a period of one (1) hour. Full rated power shall then be reapplied for twelve (12) more hours. This cycle of 12 hours on, 1 hour off, shall continue until all twenty seven (27) Type I lamps, or all twenty (20) Type II lamps, fail due to filament failure.

The life test power cycle shall include a Photometric Test and verification of the marking requirement durability of section 3.4.

At the minus three sigma (-3σ) hours of rated power operation of the submitted design, the beam candela output shall not be less than ninety-five percent (95%) of the initial candela established for the individual lamp by the Photometric Test.

The life test shall include a continuing measurement of individual lamp wattage. Beginning at the offerer's stated -3σ hours of operation; individual lamp terminal voltage shall be measured and recorded. This voltage measurement shall be made, on every lamp, at the midpoint of every twelve (12) hour power on cycle of the life test. When the terminal voltage of any individual lamp, compared to the initial lamp terminal voltage established by the wattage test, confirms a change in lamp wattage exceeding one hundred fifteen percent (115%) of the initial value, the rated life of the lamp is ended. Testing continues to filament failure.

The testing laboratory shall perform a statistical analysis of the results of the life test for each submitted qualification sample.

5. PREPARATION FOR DELIVERY

5.1 General

Lamps shall be packaged for extended warehouse storage and reshipment. Packaging shall be in accordance with ASTM D 3951. Testing or validation shall be in accordance with ASTM D 4169, Assurance level II, and Distribution cycle 18.

5.2 Packaging

Each lamp, with one (1) inch cushioning, shall be packaged in an individual (unit package) fiberboard container.

Unit packages shall be over packed in intermediate containers with 12 unit packages per container.

Intermediate packaging and shipping containers shall be capable of multiple handling and storage under favorable conditions, such as enclosed facilities, for a minimum of one year.

5.3 Palletized Shipments

All palletized shipments shall be made on disposable pallets whose maximum outside dimensions are forty seven and one-half inches (47 ½") by forty inches (40"). Overall height of the pallet and contents shall not exceed forty-seven inches (47"). Fork entry of the pallet shall be on the long sides of the pallet. No
portion of the load shall overhang or extend beyond any pallet edge. Shrink wrapping to secure intermediate containers is encouraged.

5.4 Marking

Unit and intermediate packages, shipping containers and palletized loads shall be marked in accordance with MIL-STD-129. Unless specifically exempted by other contract documents or purchase order requirements, bar coding in accordance with MIL-STD-129L (Reference appendix H, 20.1, 20.7, 20.8, 20.9, and 20.10) shall be applied.

The appropriate marking order is:
Bar Code
National Stock Number (NSN)
CAGE Code and Part Number
Item Description
Quantity and Unit of Issue
Contract Number or Purchase Order Number

Level of Protection and Date Packed
Lamp Life
Sigma Hours

6. NOTES

The contents of the subparagraphs below are only for information. They are not contract requirements, and are not binding on either the Government or the contractor except to the extent that they may be specified as such in other contract documents. Any reliance placed by the contractor on the information is wholly at the contractor's own risk.

6.1 Government Furnished Equipment

None.

6.2 Packaging Testing

It is recommended the contracting officer direct initial shipment of all qualification samples to themselves. When all qualification samples are received, one carrier, in one shipment, should transport all the samples to the independent testing laboratory. The receiving testing laboratory should inspect the packing and packaging as received for conformance and effectiveness.

6.3 Information - Lumen Output of Halogen Cycle Lamps

The "y" constant for various halogen cycle lamps has been found to be close to 5.56. The "y" constant is the constant used in C. E. Weitz' equations for relating lumen output to ampere input for incandescent lamps. These equations were
first published by the General Electric Company in their LD-1 Lamp Bulletin in 1956.

The fit of the curve extended to the limits of the range of input power in use. We would appreciate any comment or correction to our findings.

6.4 Information Request, and Reason for Request.

The equation set referred to in section 6.3 also contains those which can predict the extended life of a lamp design when operated at less than full rated power. The equations are noted as valid within ten percent (10%) of full rated power.

We have been unable to locate any valid means to project life extension of halogen cycle lamps when operated at reduced power levels.

A means of projecting realistic lamp life for the operating currents in use is one of the requirements for a viable group re-lamping program. Approach lighting systems can

easily have over one hundred (100) lamps. The distance (time) of travel alone is a significant labor cost when spot replacement is done.

It is realized that requiring all potential suppliers to furnish this information would impose an unfair burden on those who have not conducted research on extended life of this type of lamp. It is requested that those who have valid information, provide it.

6.5 Vibration Data, reference 3.4.8.8

This data will be used to help identify structures whose resonant frequency may well be the cause of shortened lamp life

6.6 Factors Affecting the Ability to See An Object

The ability of the human eye to detect and identify a lighted object, or a light source is affected by:

1. The intensity or brightness of the object.
2. The size of the object.
3. The contrast between the object and the surrounding area background.
4. The distance from the object.
5. The time available to the observer to detect and identify the object.

The real customer of the light produced by the lamps defined by this specification is the pilot of any aircraft landing at night. All five of the listed factors are applicable.

6.7 Spectrum Tuning

A portion of Type I and all Type II lamps are used with color filter lens approximately two (2) inches in front of the lamp face. The FAA uses both red and green filters. A single lamp design cannot produce the best possible beam distribution for an unfiltered column of “white” light and a uniform distribution to the color filter lens. Any spectrum of output from incandescent or a halogen cycle lamp seen to date is a compromise, if visible light, in red and green and white, is the objective.

Is it economically and technically possible to produce lamps whose lens or cover is also a color filter? The tradeoffs in logistic support will eventually cancel if it is possible. All three colors are defined in military specification MIL-C-7989B.

6.8 Ultraviolet Emission and Lamp Structural Integrity

All halogen cycle lamps emit ultraviolet radiation at some level. Lamps of this type sold commercially usually have a caution on their box or carton to not operate this lamp with a cracked or defective seal. The lens or cover is also a filter to reduce the ultraviolet level

to one thought safe. Lamps that will meet this specification are quite likely to be halogen cycle incandescent lamps.

The International Electromechanical Commission, IEC, International Standard 432-2 has a requirement (2.11 UV radiation) that limits the output power of ultraviolet of halogen cycle lamps in normal operation. This international standard does not apply in the United States. We understand the Canadian Standards Association is in the process of adopting IEC standards 431-1 and 431-2.

Halogen cycle lamps in the PAR shape we require consist of a small sealed capsule, under relatively high pressure, which contains the filament in a halogen atmosphere. The structural failure of this capsule, combined with a fractured lens or cover, could project glass fragments outward at significant velocities.

Table I. Type I Lamp Requirements

All minimum beam candela requirements are referenced from the mechanical centerline (axis) in degrees. The specified locations define the boundary of the beam area of the lamp. All corners of all beam patterns may have a radius not to exceed one degree (1°) Burning position, all, horizontal to twenty-five degrees (25°) base down. All are mogul end prong base.

Ordering Designation Q6.6/PAR/56/2.

Rated amperes = 6.6.
Wattage rating in watts = 200.
Maximum candela intensity at any point, or in any direction = 25,000.

Minimum Candela
2.5° up- 14° left = 10,000. 2.5° up- 14° right = 10,000.
2.5° down-14° left = 10,000. 2.5° down-14° right = 10,000.

Ordering Designation Q20A/PAR56/C.

Rated amperes = 20.
Wattage rating in watts = 300.
Maximum candela intensity at any point, or in any direction = 28,000.

Minimum Candela
3.5° up- 13.5° right = 16,000. 3.5° up- 13.5° left =16,000.
3.5° down-13.5° right = 16,000. 3.5° down- 13.5° left =16,000.

5° up- 15° right =8,000. 5° up- 15° left = 8,000.
5° down-15° right =8,000. 5° down-15° left =8,000.

Ordering Designation Q20A/PAR56/1/C.

Rated amperes = 20.
Wattage rating in watts = 500.
Maximum candela intensity at any point, or in any direction = 55,000.

Minimum Candela
4° up -14° right = 24,000. 4° up -14° left = 24,000.
4° down-14° right = 24,000. 4° down-14° left = 24,000.

Table II. Type II Lamp Requirements.

All minimum beam candela requirements are referenced from the mechanical centerline (axis) in degrees. The specified locations define the boundary of the beam area of the lamp. All corners of all beam patterns may have a radius not exceeding one degree (1°). Burning position, all, horizontal to base down. All are screw terminal base.

Ordering Designation Q20A/PAR56/2.

Rated amperes = 20.
Wattage rating in watts = 300.
Maximum candela intensity at any point, or in any direction, = 175,000.

Minimum Candela
1.5° up-3° right = 87,000. 1.5° up-3°left = 87,000.
1.5° down-3° right = 87,000. 1.5° down-3° left = 87,000.

Ordering Designation Q20A/PAR56/3.

Rated amperes = 20.
Wattage rating in watts = 500.
Maximum candela intensity at any point, or in any direction, = 300,000.

Minimum Candela
1.5° up -3° right = 180,000. 1.5° up -3° left = 180,000.
1.5° down -3° right = 180,000. 1.5° down -3° left = 180,000.

Table III. Qualification Tests.

Required Tests In Sequence.	Type I Lamps 27 of 30	Type II Lamps 20 of 22	Page Reference
Wattage Rating	YES	YES	21
Photometric	YES	YES	22
	Type I Lamps 20 of 30		
Overload and Photometric	YES	YES	22
Low Pressure Method 500.4	YES	YES	23
Cold Rain Method 506.4	YES	NO	23
	Type I Lamps 7 of 30		
High Temperature & Humidity	NO	YES	24
Sand and Dust Method 510.4	YES	NO	25
Salt Fog Method 509.4	YES	YES	25
Icing Method 521.2	YES	NO	25
Low Temperature Method 502.4	YES	YES	26
	Type I Lamps 27 of 30	**Type II Lamps 20 of 22**	
Life and Candela Maintenance, Marking	YES	YES	26

(YES = Test Required. NO = Test not required).

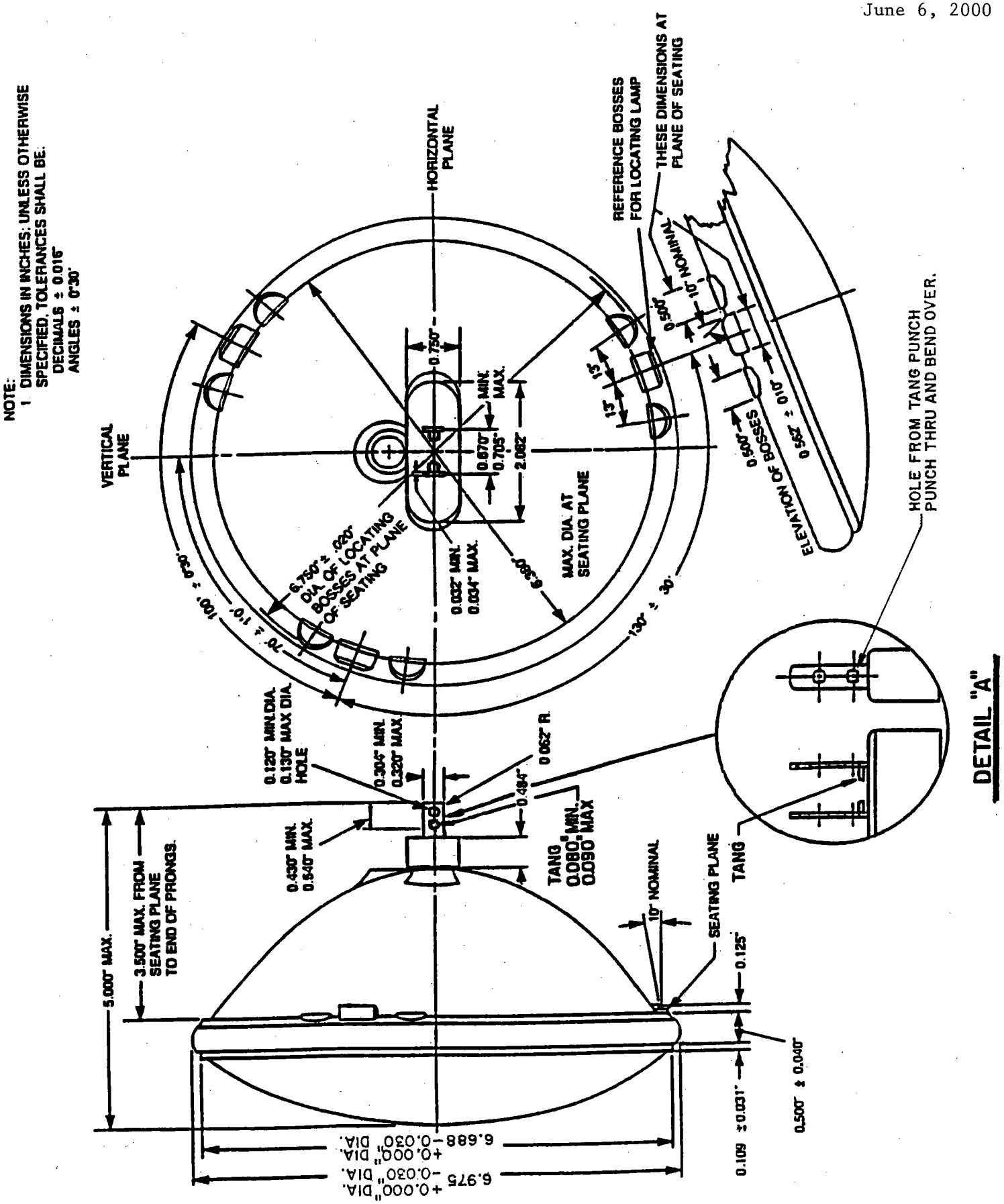


Figure 1. Lamp, PAR-56 Bulb, Mogul End Prong, Outline Dimensions

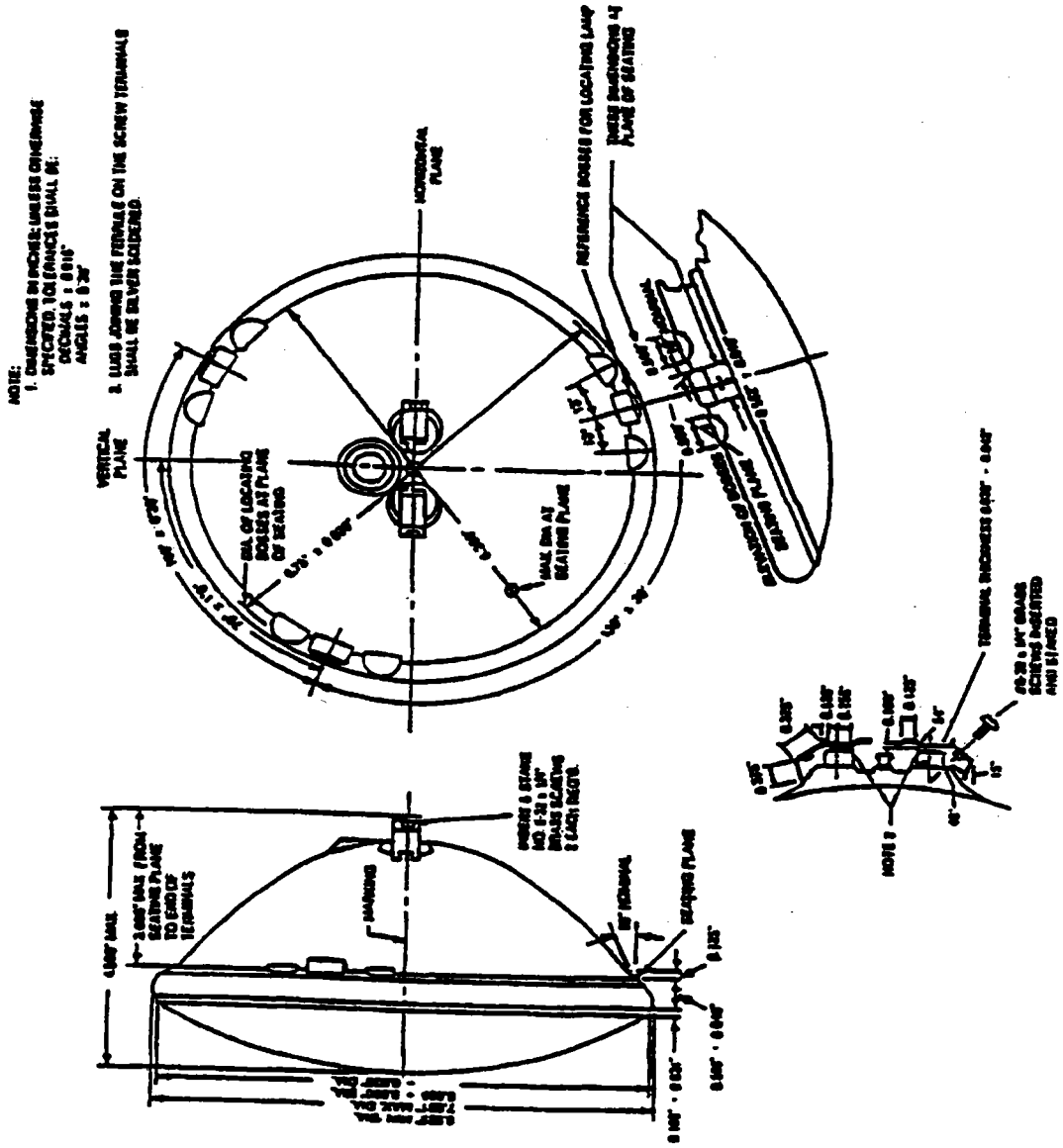


Figure 2. Lamp, PAR-56 Bulb, Screw Terminals, Outline Dimensions

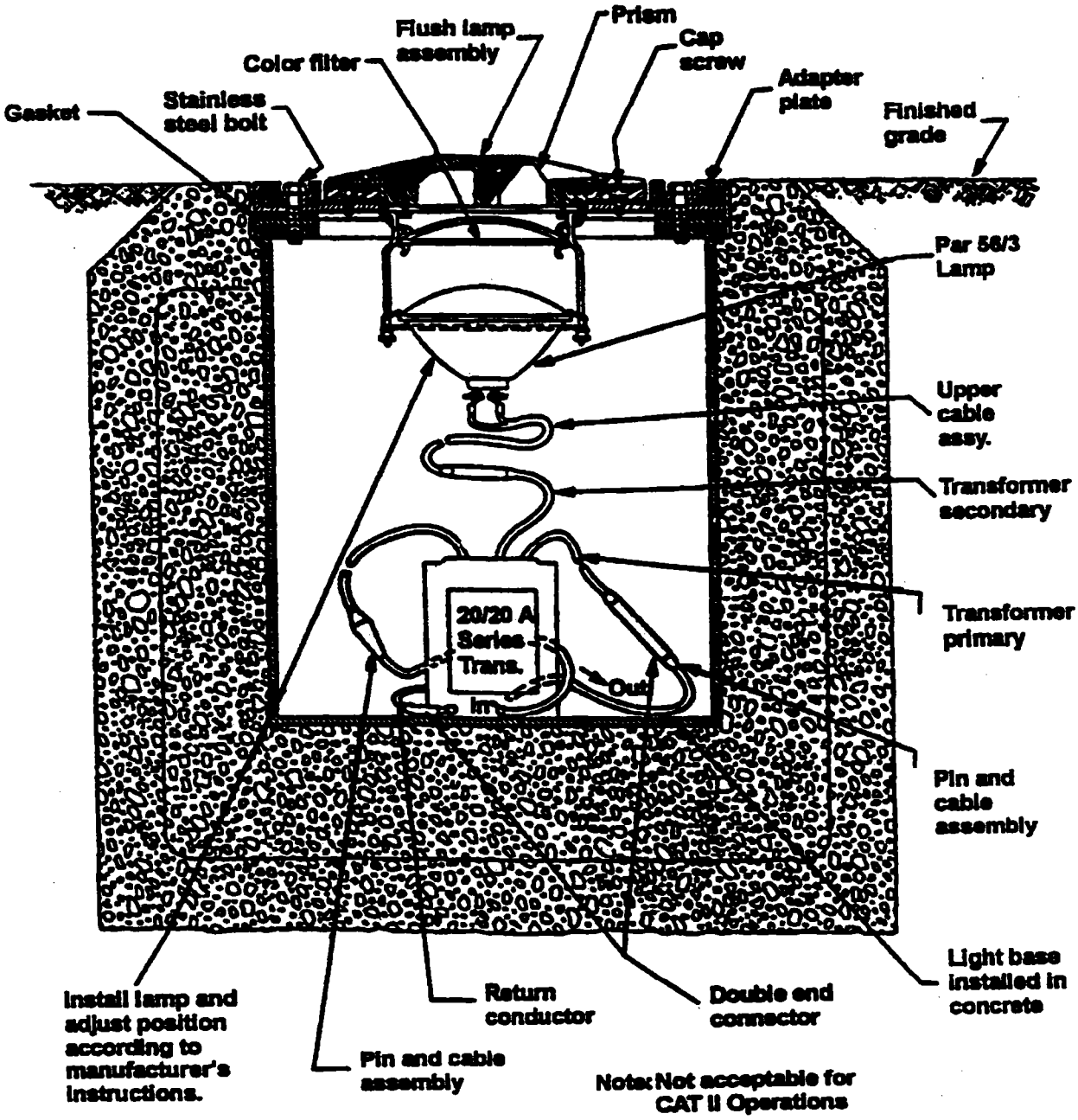
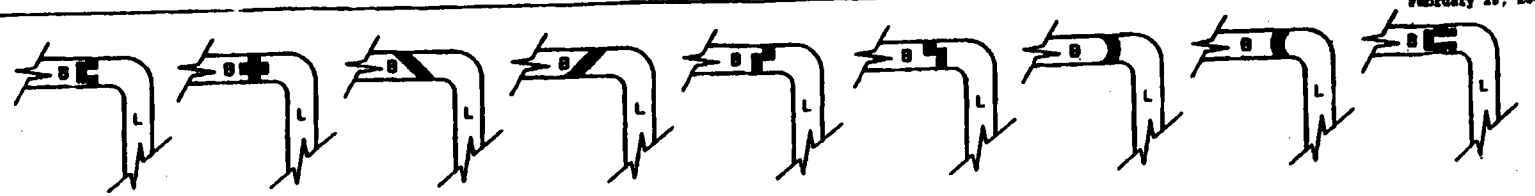
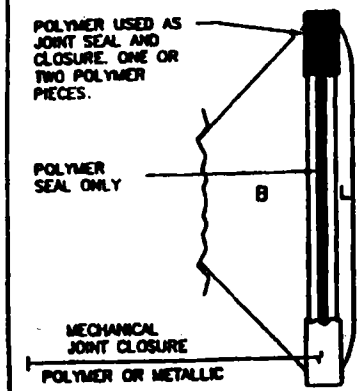


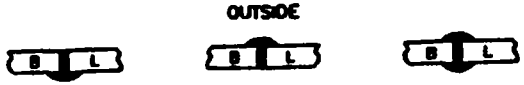
Figure 3. Typical ALS Flush Lamp Installation



AN INCOMPLETE VARIETY OF POSSIBLE POLYMER-JOINT SHAPE ILLUSTRATIONS



THREE POSSIBLE VARIATIONS OF POLYMER ILLUSTRATED ON A TRADITIONAL PAR LAMP SHADE.



POLYMER MAY BE INSIDE, OUTSIDE OR ON BOTH SIDES OF ANY JOINT.

NOTES:

1. LAMP IS HEREBY DEFINED AS A LIGHT EMITTING ASSEMBLY OF ANY COMBINATION OF GLASS OR METALLIC SHAPES ASSEMBLED AROUND AND/OR ENCLOSING A LIGHT SOURCE.
2. THE LETTER "L" IS USED ON THIS DRAWING TO IDENTIFY THE LENS PORTION A LIGHT EMITTING ASSEMBLY.
3. POLYMER IN ALL ILLUSTRATIONS IS THE SHADED PORTION, THUS ▰.
4. LENS IS DEFINED AS THE PORTION OF THE LIGHT EMITTING ASSEMBLY WHERE THE LIGHT EXITS THE ASSEMBLY. FACE OR COVER ARE SYNONYMS FOR LENS ON THIS DRAWING.
5. THE LETTER "B" IS USED ON THIS DRAWING TO IDENTIFY THE BODY OF A LIGHT EMITTING ASSEMBLY. BODY IS HEREBY DEFINED AS ALL PARTS AND PORTIONS OF SAID ASSEMBLY EXCEPT THE LENS DEFINED IN NOTE 3.
6. THIS DRAWING ILLUSTRATES AN INCOMPLETE VARIETY OF DESIGN CONCEPTS PRESENTED IN F.A.A. SPECIFICATION FAAD-F-1375.

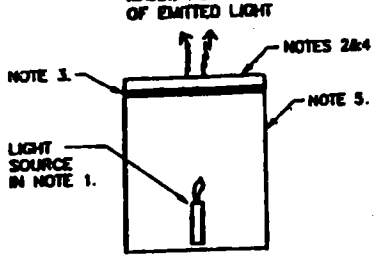


ILLUSTRATION OF NOTES.

SCALE NONE

REV LTR	DATE	DESCRIPTION	DRWG	APPD
A	3/5/99	CHANGED FROM DWG NO. DE-B-3388 DATED 5/17/1994		

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
MIKE MONRONEY AERONAUTICAL CENTER — OKLAHOMA CITY, OKLAHOMA

DESIGN CONCEPTS POLYMER CLOSURE OF LAMPS

REVIEWED BY	DESIGNED BY	SUBMITTED BY	APPROVED BY
	E.D.EVANS		
	DRAWN BY R.W.H.	ISSUED BY FAALC ENGINEERING AND PRODUCTION BRANCH	DATE 3/5/99
	CHECKED BY		DRAWING NO. DE-B-3388 REV LTR A

LAMP LIFE DEFINITION

THIS DRAWING, AND THE DEFINITIONS HEREIN, ESTABLISH A STANDARD DEFINITON OF LAMP LIFE FOR THE FEDERAL AVIATION ADMINISTRATION LOGISTICS CENTER, FAALC. THE DETAILED SPECIFICATION, OR OTHER ACQUISITION DOCUMENT, WILL ESTABLISH THE MINIMUM ACCEPTABLE LIFE FOR ANY SPECIFIC LAMP.

LAMP LIFE IS HEREBY DEFINED AS THE AVERAGE LIFE OF A STATISTICALLY VALID LARGE GROUP OF IDENTICAL LAMPS OPERATED AT FULL RATED POWER. THE GUIDELINES AND METHODS OF IEC 64 FOR ESTABLISHING LAMP LIFE SHALL APPLY, EXCEPT FOR THOSE SPECIFICALLY MODIFIED HEREIN, OR THOSE MODIFIED BY A DETAILED LAMP SPECIFICATION.

IEC 64 IS THE INTERNATIONAL STANDARD TITLED "TUNGSTEN FILAMENT LAMPS FOR DOMESTIC AND SIMILAR LIGHTING PURPOSE." "PERFORMANCE REQUIREMENTS." THE IEC IS THE COMMISSION ELECTROTECHNIQUE INTERNATIONALE/INTERNATIONAL ELECTROTECHNICAL COMMISSION.

UNLESS OTHERWISE SPECIFIED BY THE DETAILED SPECIFICATION FOR THE SPECIFIC LAMP, THIS LIFE TEST IS PERFORMED IN THE FOLLOWING MANNER AND ENVIRONMENTAL CONDITIONS:

AMBIENT AIR
TEMPERATURE OF: 70 DEGREES, PLUS OR MINUS 5 DEGTEES, FAHRENHEIT.
UNCONTROLLED RELATIVE HUMIDITY.
AMBIENT AIR SURROUNDING THE LAMP, EXCLUDING ANY LAMP HEAT INDUCED AIR MOVEMENT, SHALL HAVE A TOTAL VELOCITY OF LESS THAN 1 MILE PER HOUR (1.46 FEET PER SECOND).

POWER
FLUCTUATIONS OF SUPPLY VOLTAGE MEASURED AT THE LAMP SHALL NOT EXCEED PLUS OR MINUS ONE PERCENT (0.1σ) AT ANY TIME.
ALTERNATING CURRENT SHALL HAVE A TOTAL HARMONIC DISTORTION NOT EXCEEDING 3σ.
ALTERNATING CURRENT SHALL HAVE A CREST FACTOR BETWEEN 1.38 AND 1.44.

MOUNTING
THE LAMP SHALL BE MOUNTED IN AN APPROPRIATE RECEPTACLE, IN THE ORIENTATIONS, FOR WHICH IT IS DESIGNED. MULTIPLE MOUNTING ORIENTATIONS DESIGNS SHALL BE TESTED CAP UP. THE DETAILED SPECIFICATION FOR ANY LAMP WILL DEFINE THE SPECIFIC RECEPTACLE OR MOUNTING FOR A SPECIFIC APPLICATION AND THE MOUNTING ORIENTATION REQUIRED.

AGEING/BURN IN/CONDITIONING
THESE THREE TERMS ARE UNDERSTOOD TO MEAN THE SAME TIME INTERVAL AND PURPOSE. AGEING OF LAMPS FOR TESTING SHALL BE DONE WITH THE POWER CONDITIONS DEFINED IN THIS TEXT FOR A PERIOD EQUAL TO ONE PERCENT (1σ) OF THE LIFE, AS DEFINED HEREIN, OF THE SPECIFIC LAMP. THIS SHALL BE DONE AT FULL RATED POWER UNLESS SPECIFICALLY DEFINED BY A DETAILED SPECIFICATION FOR THE LAMP(S).

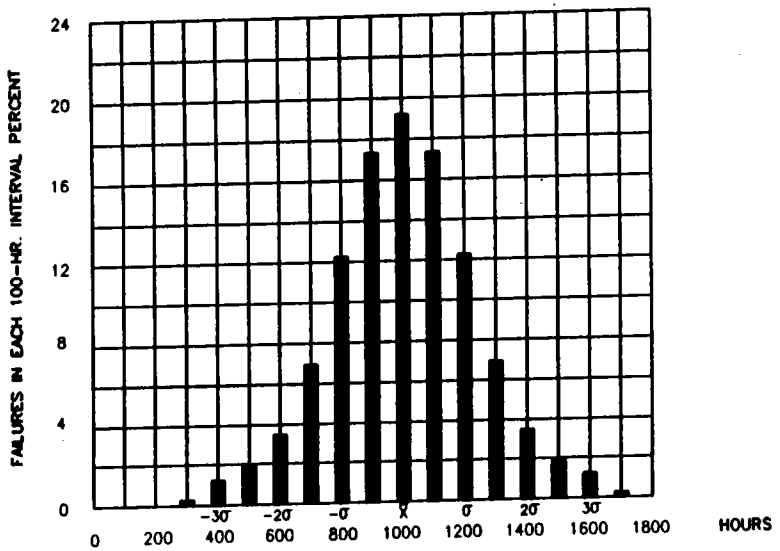
LIFE TEST POWER CYCLE
UNLESS SPECIFIED DIFFERENTLY BY THE DETAILED SPECIFICATION, ALL LAMPS BEING TESTED FOR LIFE SHALL BE SWITCHED OFF TWICE DAILY FOR A PERIOD OF NOT LESS THAN FIFTEEN (15) MINUTES. THE OFF TIME IS NOT INCLUDED IN THE OPERATING HOURS OF THE LAMP.

ALL LAMP LIFE TESTS SHALL BE DONE AT FULL RATED INPUT POWER FOR THE SPECIFIC LAMP. UNLESS SPECIFICALLY DEFINED BY A DETAILED SPECIFICATION, OFF-ON SWITCHING SHALL BE DONE AT FULL RATED INPUT POWER.

LAMP LIFE FOR THE FAALC
LAMP LIFE IS DEFINED AS THE MEDIAN OPERATING HOURS OF THE NORMAL DISTRIBUTION PLOT FOR THE SPECIFIC LAMP DESIGN. 50σ OF THE LAMPS FAIL BEFORE THE MEDIAN HOURS OF OPERATION AND 50σ FAIL AFTER THE MEDIAN HOURS OF OPERATION. IN STATISTICAL TERMS THE X BAR ($\bar{X}$) IS THE MEDIAN OR AVERAGE NUMBER OF HOURS OF THE PLOTTED DISTRIBUTION OF SUCCESSFUL OPERATING HOURS.

SIGMA (σ) IS DEFINED AS THE STANDARD DEVIATION OF THE NORMAL DISTRIBUTION PLOT FOR THE SPECIFIC LAMP DESIGN. MINUS OR NEGATIVE SIGMA'S ARE DEFINED AS THE NUMBER OF STANDARD DEVIATION HOURS LESS THAN THE MEDIAN OR X BAR VALUE FOR THE SPECIFIC LAMP DESIGN. THE DETAILED SPECIFICATION, OR OTHER ACQUISITION DOCUMENT, DEFINE THE ACCEPTABLE VALUES FOR LAMP LIFE AND MINUS OR NEGATIVE THREE SIGMA (-3σ) FOR THE SPECIFIC LAMP.
WHEN REQUIRED BY THE DETAILED SPECIFICATION, OR OTHER ACQUISITION DOCUMENT, THE VALUE OF SIGMA FOR THE SPECIFIC LAMP SHALL BE FURNISHED. LAMP LIFE WHEN TESTED BY THE FAA SHALL VERIFY OR VALIDATE THE LAMP LIFE STATED BY THE MANUFACTURER FOR THE SPECIFIC DESIGN.

EXTENDED LIFE INFORMATION
THE FAA OPERATES MANY LAMPS AT LESS THAN FULL RATED POWER TO ADJUST THE VISIBLE LIGHTS LEVELS TO THE REQUIREMENTS OF THE APPLICATION. WHEN REQUIRED BY THE DETAILED SPECIFICATION FOR A SPECIFIC APPLICATION THE MANUFACTURER SHALL PROVIDE LIFE EXPECTANCY VALUES FOR THE SPECIFIED POWER RANGE. THESE VALUES OF LIFE EXPECTANCY MAY BE FROM TEST DATA OR STATISTICAL PROJECTIONS FROM OTHER TESTS. THE BASIS FOR, AND METHODS OF, PROJECTIONS USED SHALL BE INCLUDED WITH THE LIFE EXPECTANCY DATA.



DISTRIBUTION OF LIFE OF A SPECIFIC LAMP DESIGN
OPERATED AT RATED VOLTAGE; $\bar{X}$ = 1,000, σ = 200.

NORMAL DISTRIBUTION PERCENTAGES OF EVENTS IN INTERVALS TABLE.

OPERATING TIME	APPROXIMATE	NUMBER OF EXPECTED FAILURES
BEFORE -3σ AND AFTER +3σ	TOTAL 0.27%	.135% BEFORE, .135% AFTER
BETWEEN -3σ HUURS AND -2σ HOURS		2.14%
BETWEEN -2σ HOURS AND -1σ HOUR		13.59%
BETWEEN -1σ AND X BAR HOURS		34.135%
ZERO TO X BAR HOURS		50% =RATED LIFE.

REV LTR	DATE	DESCRIPTION	CHK'D	APP'D
A	6/6/00	CHANGED NOTES, AMBIENT AIR AND POWER		

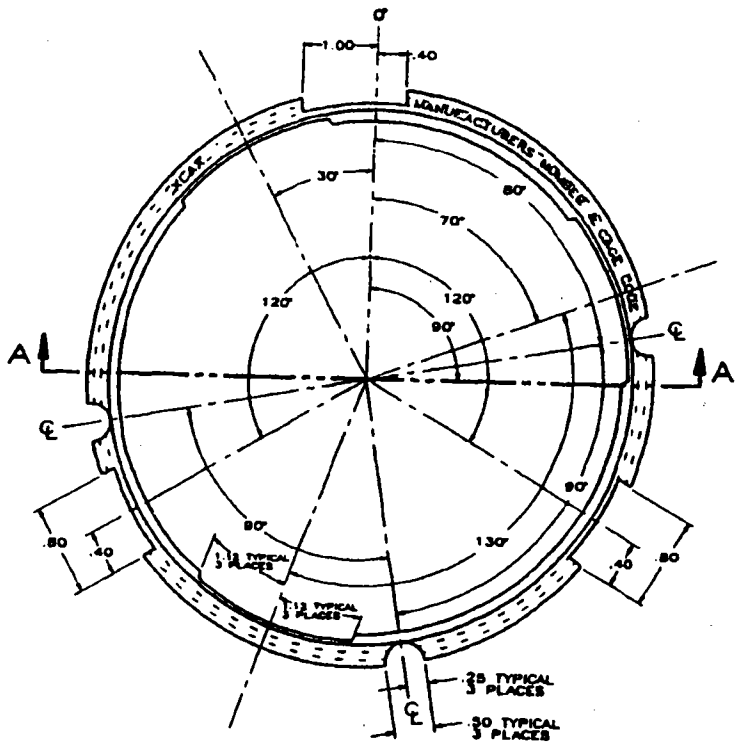
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
MIKE MONRONEY AERONAUTICAL CENTER OKLAHOMA CITY, OKLAHOMA

LAMP LIFE DEFINITION

REVIEWED BY	SUBMITTED BY: EARL D. EVANS P.E.	APPROVED BY: PAUL SOLHEIM	
DESIGNED BY	ISSUED BY: FAALC AML-460	DATE: 11 / 24 / 98	REV LTR: A
DRAWN BY		DRAWING NO.: DE-C-3390	
CHECKED BY: L. CLARK			

NEXT ASSEMBLY | USED ON | APPLICATION

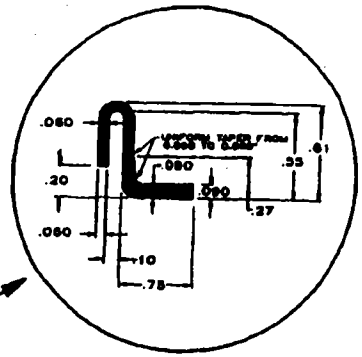
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
ANGLES ± 1/2°
FRACTIONS ± 1/16"
MACHINE FINISH 125
DO NOT SCALE DRAWING



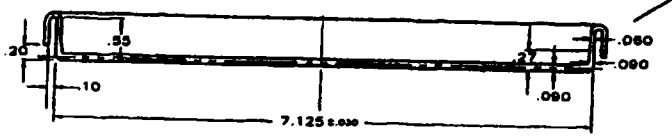
TOP VIEW

NOTES:

1. ALL UNDIMENSIONED RADII TO BE FOR OPTIMUM MOLDING UNIFORMITY.
2. TOLERANCES – FINAL MOLDED PRODUCT.
   GAUGE ±0.008". OVERALL DIAMETER ±0.030". ALL OTHERS SPECIFIED ±0.010"
   ANGLES – REFERENCED BACK TO ZERO (0°) DEGREES ±0.5 DEGREE.
3. SPECIFICATIONS FOR WASHER:
   A. MATERIAL: SILICONE RUBBER COMPOUND
   B. SERVICE TEMPERATURE: 500°F MINIMUM
   C. LOW TEMPERATURE BRITTLE POINT:
      METHOD A, ASTM D-2137 -70°F MINIMUM
   D. TENSILE, ELONGATION, TEAR STRENGTH AND HARDNESS TESTED IN ACCORDANCE WITH ASTM D-1349, 23±2°C, 50±RH
   E. TENSILE STRENGTH:
      METHOD A, ASTM D-412, PSI 500 MINIMUM
   F. ELONGATION:
      ASTM D-±412, PERCENT (%) 240 MINIMUM
   G. TEAR STRENGTH:
      ASTM D-624, DIE B METHOD, lbf/inch 100 MINIMUM
   H. THERMAL CONDUCTIVITY:
      0.34W/m·°C or 2.4BTU·in/hr·sq.ft.·°F plus or minus 10%
   I. HARDNESS:
      ASTM D-2240, SHORE A 40±5
   J. HEAT RESISTANCE, ASTM D-573, 70hrs @ 225±2°C
      ASTM D-2240 HARDNESS CHANGE, ± SHORE A -10 MAX, -0 MAX
      ASTM D-412 TENSILE STRENGTH CHANGE, % -20 MAXIMUM
      ASTM D-412 ELONGATION CHANGE, % -40 MAXIMUM
   K. COMPRESSION SET:
      ASTM D-395, METHOD B, 70hrs @ 225±2°C 25% MAXIMUM
   L. WATER RESISTANCE:
      ASTM D-471, 70hrs @ 100±2°C, VOLUME CHANGE, % +10 MAXIMUM
   M. SPECIFIC GRAVITY: NONE SPECIFIED, FURNISH
   N. PREFERRED COLOR: RED
   O. PART NUMBER: XLAX IN LOCATION SHOWN. MANUFACTURERS NUMBER & CAGE CODE IN LOCATION SHOWN ALL 1/8" TO 1/4" CHARACTERS.



LEFT HALF SECTION A–A
SCALE: 2" = 1"



NOTE: THE DIMENSIONS OF THIS DRAWING ARE TAILORED TO SAFELY FIT LAMPS IN ACCORDANCE WITH SPECIFICATION FAAD-F-1375. OTHER LAMPS MAY BE TOO LARGE, OR SMALL, IN OUTSIDE DIAMETER THAN IS DESIRED FOR OPTIMUM FIT. OPTIMUM OUTSIDE DIAMETER IS 6.975 +.030 −.032

REFERENCE DRAWINGS: LAMP HOLDERS, FAA C-4761-1, GENERAL ASSEMBLY, DE-C-3394
LAMPS, FAA C-5407-1, C-5407-2 AND C-5407-6

DO NOT SCALE

FULL SCALE

NSN: 5970-01-462-3685

REV LTR	DATE	DESCRIPTION	DRAWN	APPD
A	5/5/99	NSN: 5970-01-462-3685		

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
MIKE MONRONEY AERONAUTICAL CENTER — OKLAHOMA CITY, OKLAHOMA

HI-TEMP. POLYMER FILLER WASHER FOR PAR-56 LAMPS IN FAA HOLDERS

DE-C-3394		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	REVIEWED BY	SUBMITTED BY	APPROVED BY
		TOLERANCES ARE AS FOLLOWS			
		FINISH "D"			
NEXT ASSEMBLY	USED ON	DO NOT SCALE DRAWING	DRAWN BY	ISSUED BY: FAALC ENGINEERING AND PRODUCTION BRANCH	DATE 1 / 11 / 99
APPLICATION			TRACED BY		DRAWING NO. DE-C-3394-1 REV LTR A